Service Model

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Locations

We believe that the infrastructure given by the World Wide Web is a solid foundation for the virtual world we are going to model. Addresses and links of the Web are based on Universal Resource Locators (URL). URLs and their superset Universal Resource Names (URN [RFC2141]) will probably represent locations on the Web for a long time to come. We will use the term URL, but all concepts can be applied equally to URNs as soon as they are being used on the Web.

We are regarding Web pages, and all other types of network accessible documents, as locations in the virtual world. These virtual locations correspond to places in the real world like rooms, street corners, and stores. People are moving - browsing - between virtual locations via hypertext references. Hypertext references (called links) are the connections between locations. They correspond to streets and paths in the real world. The only difference is that it is not possible to stop on the street until the destination is reached.

Locations do not necessarily require static HTML pages. There are many abstract locations imaginable, e.g. those mentioned above, which are based on user skills and interests. These locations are not part of the URL space. However, they can be represented by URLs for the purpose of a dynamic neighborhood model. Their URLs consist of the address of the service provider or the database server and the user's parameters (e.g. coded interests).

Links

Links between locations are currently used only as interconnections. But they have other important features. The rel-attribute of HTML-links is an example of a link attribute which contains meta-information. We propose - and use in our implementation - an additional distance-attribute to the anchor-tag of HTML to indicate the strength of interconnection. Locations can be far apart in the virtual world even if they are linked with a hypertext reference. This is useful to separate documents, which are linked but not related to each other. Examples are hotlist pages (or bookmark pages), which link to many unrelated documents. The opposite case is a distance of 0. A 0-distance combines the linked documents to a single virtual one. The distance-attribute defaults to 1 if absent, which of course is the normal case for unmodified Web sites. The distance-attribute either contains numerical values in units of hypertext references (float values), or a named relationship. Currently, defined named relationships are "near", "far", and "unrelated".

In most cases there is only a uni-directional hypertext reference between pages. This is the reason for the well known "dangling links"-problem (e.g. see [Fielding94]). We decided to treat links between documents as symmetric to allow for symmetric visibility. This decision is not part of the neighborhood model and it can be changed in a different implementation.

Meeting Rooms

The "unrelated"-distance-attribute mentioned above indicates complete separation of locations like a wall between rooms. While people can move easily between pages by clicking on the hypertext reference, they cannot see what's behind the wall. Essentially the "unrelated"-marked anchor tags in HTML documents are ignored.

This feature is useful to create virtual meeting rooms and closed groups. VMRs on the Web are represented by URLs and documents. They can be linked into the Web via hypertext references like any other Web page. Access control is provided by the Web's native mechanisms. If references to the VMR's documents are marked as "unrelated", they are like solid walls around a meeting room. This shows that the distance of links is not necessarily symmetric.

Static virtual meeting rooms fit very well into the dynamic neighborhood. They are just a special case. The configuration of Web pages of a VMR is such that all persons in the VMR have the same view - the same visible area.

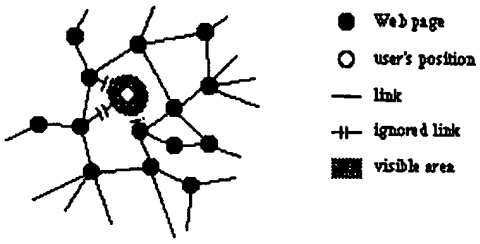

Figure 3: The visible area is restricted by links, which are marked with an "unrelated"-distance. The page is isolated from the Web. Isolation means that it is not possible to watch the surroundings from the page and vice versa.

Persons and Communication

The virtual world contains more than just locations and links. Humans, and other active entities (e.g. robots) are acting in the space constituted by URLs. We identified two important types of actions. The first is movement through the virtual world, as it has been described above. The second action is communication between active entities, e.g. humans or agents. In the real world we do not only see other persons in the neighborhood, but we communicate via various means, or we at least notice communication between people.

Both persons and communication add a new dimension to the Web. Whereas the Web serves as the environment, persons and communication exist within the space created by the Web. Of course, persons are not present everywhere while they are browsing the Web. The presence is limited to their position and its surroundings. The strength of presence - or visibility - of persons depends on their visibility-function. The visibility-function is a function of the distance from the person's position. The distance is measured in a metric imposed on the underlying hyperspace, the Web. The obvious choice as a metric are the hypertext references as described above, but others such as document content overlap are imaginable.

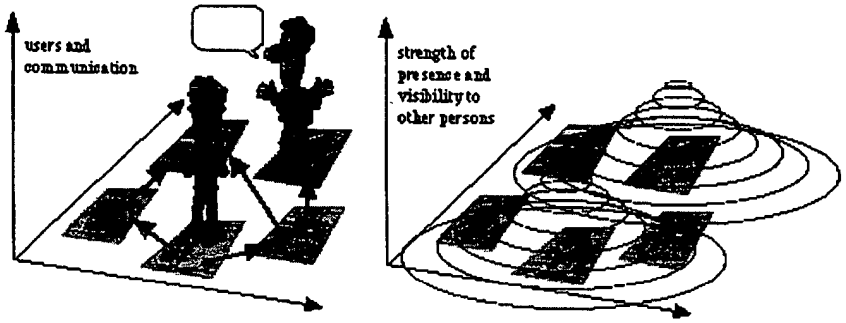

Figure 4: The Web is the base infrastructure of the virtual world. Other objects add new dimensions. The Web is depicted as 2 dimensional hyperspace although it is actually a graph. The left side shows a simplistic representation of 2 persons at different locations. The right side shows the values of the persons' visibility-functions. People can communicate if the visibility overlaps.

Communication between persons can be established if their visibility-functions overlap. The communication itself is carried out by synchronous services such as the MBONE tools or Internet telephony. The communication quality is beyond the scope of the neighborhood model, i.e. the quality is not degraded for small overlap of visibility functions as opposed to the real world.

Communication is represented by communication objects. These objects fit well into the dynamic neighborhood model. Communication objects - like persons - have a visibility-function. The function depends on the properties of the objects involved. The communication is visible to a third person, if the visibility and the visibility of the communication objects overlap. Of course there are provisions for privacy, if this is

desired.

Communication objects serve as coordinating instances, e.g. a communication object for MBONE tools allocates multicast addresses, and distributes the respective URL to the user interfaces. Communication objects for point-to-point communication tools distribute the communication URLs of the user's tools, e.g. RTSP-URLs.

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